9:15

730-4 Transesophageal Dynamic 3-Dimensional Reconstruction of Flow Jets in Assessing Prosthetic Mitral Valve Function

T.-L. Hsu, S.-J. Ho, J.-J. Wang, S.-T. Lai, T.-J. Yu, Y. Chang, C.-C. Shih, S.-P. Wang, M.-S. Chang, N. Pandian. *Veterans General Hospital-Taipei, Taiwan, ROC, Tufts-New England Medical Center, Boston, MA, USA*

Our previous study has been demonstrated that three-dimensional (3D) flow characteristics in each prosthetic mitral valves in an in vitro models. Current dynamic voxel-based transesophageal 3D echo allows to assess the morphologic features of mitral prosthesis. In this study, we further explored the usefulness of 3D reconstruction of flow jets in assessing the prosthetic mitral valve (PMV) function. Thirty-eight patients (pts) with PMV replacement (bioprosthesis in 8 pts, bileaflets in 25 pts, Bjork-Shiley in 3 pts, Starr-Edwards in 1 pt and Medtronic-Hall in one pt.) were evaluated by transesophageal echocardiography. Simultaneous 3D reconstruction of flow jets were performed in 23 pts. *Results:* Dynamic 3DE could direct visualize the configuration, sewing ring and tissue/disc valve motion. However, the pitfalls of 3DE include reverberation from the disc valve may simulating a regurgitant jet in one pt. Three pts had one hemi-disc valve are not opening well due to the ultrasound beam directed to one of the hemi-disc valve that hindering the ultrasound signals behind the disc. In normally functioning of tilting disc valve (N = 3), 3 physiologic jets were noted. In contrast, 6 regurgitant jets emanating from each side of pivot points could be visualized in bileaflet valves. Paravalvular regurgitant jets could be accurately identified in 10 pts and easily distinguished the physiologic jets from the pathologic regurgitant jets in all pts. *Conclusions:* (1) 3D reconstruction of flow jets could aid in differentiating of para-valvular leakage with transvalvular or pseudodehiscence. (2) Technical factors such as selection of the region of interests at the center of the prosthesis and optimal threshold are essential for recognizing PMV function.

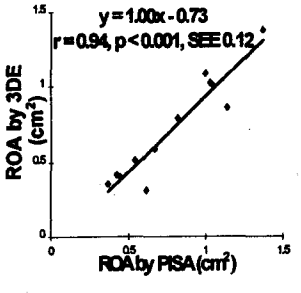
9:30

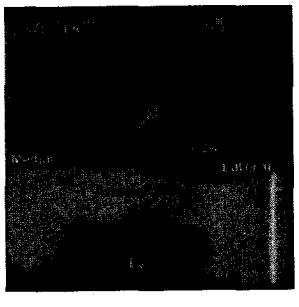
730-5 Comparison of Three-Dimensional Echo and Proximal Flow Convergence Method for Quantification of Mitral Regurgitation

C.S. Breburda, B.P. Griffin, M. Pu, G.M. Scalia, J.D. Thomas. *The Cleveland Clinic Foundation, Cleveland, OH, USA*

Regurgitant orifice area (ROA) is an important measure of the severity of mitral regurgitation (MR) which up to now has been calculated from hemodynamic data rather than measured directly. We hypothesized that improved spatial resolution of the mitral valve (MV) with three-dimensional echo (3DE) might allow accurate planimetry of ROA.

Method: We reconstructed the MV using 3D echo, 3º rotational acquisitions (TomTec) with a transesophageal (TEE) multiplane probe in 12 pts undergoing MV repair (age 61 ± 4 yrs, 8 M). ROA was directly planimetered in the 3DE reconstruction and compared to calculated maximal ROA using the Proximal Isovelocity Surface Area (PISA) method. *Results:* 3DE of the ROA was accomplished in all patients: (see figure of posterior leaflet, PL, prolapse). Maximal ROA by 3D echo correlated with that by PISA with r = 0.94, p < 0.001, SEE 0.12 with the regression line equation of y = 1.00x – 0.73. Maximal mean ROA by 3D was 0.72 ± 0.34 cm^2 and was 0.79 ± 0.32 cm^2 by PISA. The mean difference between the two techniques was 0.06 ± 0.11 cm^2.





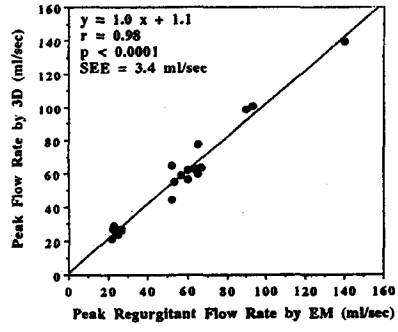
Conclusion: Maximal ROA measured by direct planimetry of the 3D images has an excellent correlation with that measured by the PISA method, while providing additional anatomical information.

9:45

730-6 Direct Calculation of 3D Flow Convergence Surface Area from 3D Color Doppler Flow Maps for Computing Aortic Regurgitant Flows: A Chronic Animal Study

X. Li, M. Jones, T. Shiota, A. Delabays, I. Yamada, N.G. Pandian, D.J. Sahn. *Oregon Hlth. Sci. Univ., Portland, USA, LAMS-NHLBI, Bethesda, MD, USA, Tufts-New England Medical Center, Boston, MA, USA*

The aim of our study was to develop and apply a 3D reconstruction method for color Doppler, which would allow direct measurement of flow convergence (FC) surface area which could be multiplied by aliasing velocity to yield aortic regurgitant (AR) flow rates *without any geometrical assumptions.* 18 different stable hemodynamic conditions in 6 sheep with surgically created chronic AR were studied. Reference AR flow data were obtained using electro-magnetic (EM) flow probes on the aorta and main pulmonary artery balanced against each other. Video composite data of color Doppler flow images of FC for AR obtained from apical epicardial positioning of a 5 MHZ ultrasound transducer were reconstructed after computer controlled 180º rotational acquisition. Flow convergence surface area was calculated by measuring FC arc length, integrating and interpolating it between 4 to 10, 2 mm slices using modified parallel slice measurements on a TomTec® system. An excellent agreement between EM derived peak regurgitant flow rates (ranging 21 to 141 ml/sec) and 3D FC calculated peak flow rates using the direct measurement of the 3D surface area of FC was obtained (r = 0.98, mean difference = 3.4 ml/sec, % difference = 2.5 ± 4.5%, Fig.).



Direct 3D measurement of FC surface area may provide estimates of AR severity without any geometrical assumptions about FC surface shape.

TUESDAY ORAL

731 Heart Rate Variability and Prognostic Implications

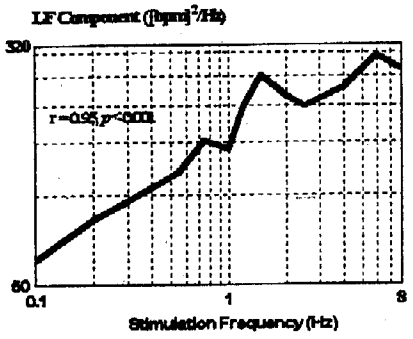
Tuesday, March 18, 1997, 8:30 a.m.–10:00 a.m.
Anaheim Marriott, South Hall

8:30

731-1 Sympathetic Stimulation Increases the Low Frequency Component of Spectral Heart Rate Variability

F. Lü, E.J. Berbari, D.P. Zipes. *Indiana University Medical Center, Indianapolis, Indiana, USA*

The use of spectral heart rate variability (HRV) to measure sympathetic activity is controversial. The purpose of this study was to test the effect of electrical stimulation of cardiac sympathetic nerves on the low frequency (LF) component of HRV spectra in pentobarbital-anesthetized dogs with surgical interruption of stellate ganglia and cervical vagi (n = 5). Stimuli for sympathetic stimulation (SS) were 4 ms in duration delivered over a frequency range of 0.1 to 8 Hz. The output of SS was adjusted to increase the heart rate to approximately 150 bpm at a frequency of 10 Hz. The LF component (0.04–0.15 Hz) of spectral HRV was computed from a 5-min surface ECG recording during each SS frequency (sampling frequency 500 Hz) using fast Fourier transformation analysis. All RR intervals files generated automatically after choosing a template were carefully inspected by the investigators. We found that there was a significant relationship (r = 0.95, p < 0.001) between SS frequency and the LF frequency component (Fig.).



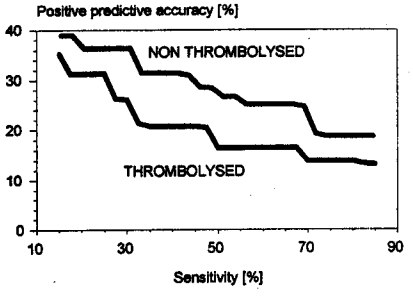
Our observation that there is a strong positive correlation between SS frequency and the LF component of HRV spectra suggests that analysis of spectral HRV can be used to assess sympathetic activity under certain circumstances.

8:45

731-2 Differences in Predictive Power of Heart Rate Variability in Thrombolysed and Non-Thrombolysed Survivors of Acute Myocardial Infarction

M. Malik, K. Hnatkova, A.J. Camm. *St. George's Hospital Medical School, London, England*

The power of reduced heart rate variability (HRV) to predict mortality after acute myocardial infarction (MI) has been established prior to the wide use of thrombolytic agents. Presently, only sparse data exist on the predictive power of HRV in MI survivors who did and did not receive thrombolytic treatment. This comparison was performed in patients of the Placebo limb of the EMIAT trial which investigated survivors of acute MI aged ≤ 75 years with left ventricular ejection fraction (LVEF) ≤ 40%. Baseline 24-hour Holter recordings were available in 592 patients (89 female, mean age 60.5 ± 9.3 years, 358 pts thrombolysed) of whom 79 (40 thrombolysed) died during a follow-up of maximum of 2 years. From the Holter recordings, HRV index values were computed. Positive predictive characteristics (PPC) were computed for the HRV based prediction of all cause mortality in thrombolysed and non-thrombolysed groups. Although reduced HRV provided stronger prediction of mortality in non-thrombolysed patients (positive predictive accuracies of 31% vs 21%, 26 vs 16% and 25% vs 16% at 40%, 50% and 60% sensitivity, respectively), the differences between the PPC curves were not statistically significant.



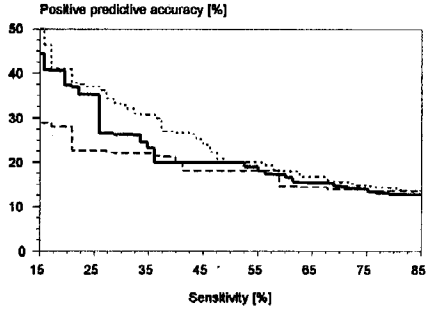
These results show that HRV remains a strong predictor of post-infarction mortality in patients receiving thrombolytic treatment. In thrombolysed patients with reduced LVEF, HRV still strongly predicts subsequent mortality.

9:00

731-3 Predictive Power of Increased Heart Rate and Depressed Heart Rate Variability in Post Infarction Patients with Reduced Left Ventricular Ejection Fraction

M. Malik, K. Hnatkova, A.J. Camm. *St. George's Hospital Medical School, London, England*

The power of increased heart rate and depressed heart rate variability (HRV) to predict subsequent mortality in post infarction patients aged ≤ 75 years with left ventricular ejection fraction ≤ 40% was examined in the data of the Placebo limb of the EMIAT trial. Baseline 24-hour Holter recordings were available in 592 patients (89 female, mean age 60.5 ± 9.3 years) of whom 79 died during a follow-up of maximum of 2 years. From the 24-hour Holter recordings, a mean normal-to-normal RR interval and the HRV triangular index values were computed for each patient. Complete positive predictive



characteristics were computed for (a) increased 24-hour mean heart rate, (b) depressed global 24-hour heart rate variability, and (c) a multivariate combination of both factors predicting subsequent all cause mortality.

The results (Fig.: full line = mean RR interval, dashed line = HRV, dotted line = combination of both factors) show that in patients with reduced LVEF, increased 24-hour mean heart rate is at least an equally good predictor of mortality as depressed 24-hour heart rate variability (positive predictive accuracy of 20.0% and 19.9% at 40% sensitivity). Combination of both factors leads to a further slight improvement in the predictive power (PPA of 26.7% at 40% sensitivity).

9:15

731-4 Autonomic Nervous System Dysfunction but Not Dispersion of Ventricular Repolarization has Prognostic Implication in Chronic Heart Failure

A. Mortara, S. Priori [1], F. Cantu' [1], M.T. La Rovere, A. Prpa, C. Napolitano [1], F. Cobelli, L. Tavazzi. *Division of Cardiology "S. Maugeri" Foundation, IRCCS, Montescano Pavia, Italy,* [1] *University of Milano, Italy*

Markers of autonomic dysfunction and dispersion of repolarization have been recently proposed for risk stratification of patients (pts) with ischemic heart disease. However their prognostic value in chronic heart failure (CHF) is still uncertain. In 165 CHF pts in sinus rhythm (age 52 ± 5, NYHA cl. II–IV, LVEF 23 ± 7, stable oral therapy), consecutively referred to our Heart Failure Unit, we assessed baroreflex sensitivity (BRS), heart rate variability (HRV by Total Variance and rMSSD) and QT and QTc dispersion (QT max – QT min in ≥9 ECG measurable leads). BRS and HRV were successfully measured in 100% pts, while 30 pts were excluded from QT analysis due to flat T waves (n = 18) and complete bundle branch blocks (n = 12). Afar a follow-up of 15 ± 9 months, 47 cardiac deaths and 30 urgent heart transplants occurred. BRS and HRV but not QT dispersion were significantly altered in deceased patients (BRS = 2.7 ± 3 vs 4.73 ms/mmHg, Total Variance = 415 ± 440 vs 755 ± 710 ms^2, rMSSD 9.6 ± 6 vs 12.7 ± 8 ms, all $p < 0.01$; QT dispersion 81 ± 27 vs 81 ± 28 ms). Using cut off values derived from the lowest 25th percentile, autonomic markers identified pts at risk (BRS < 1 ms/mmHg = RR 2.1 (1.0–6.1), rMSSD < 6 ms = 3.1 (1.2–8.1) while QT dispersion did not. Addition of QT dispersion >100 ms did not improve the power of autonomic nervous system markers in identifying pts at risk. Similar data were obtained in the prediction of arrhythmic deaths.

These results show that autonomic markers are useful for the identification of CHF patients at higher risk. Conversely, the evaluation of the pattern of ventricular repolarization can not be effectively measured in all CHF patients and it does not provide prognostic information.

9:30

731-5 Heart Rate Variability Predicts Long-term Mortality in Chronic Coronary Disease

C.Y. Tung, L.C. Lam, R. Waugh, N. Clapp-Channing, R. Harwood, R. Williams, D.B. Mark. *Duke University Medical Center, Durham, NC, USA*

Decreased heart rate variability (HRV) has been shown to predict mortality following acute MI. To assess the ability of HRV to predict all-cause mortality in chronic coronary disease, we prospectively studied 250 patients with cath proven CAD who were treated medically (mean age 62, mean EF 49%, female 30%, history of MI 53%, diabetes 27%). Mean follow-up was 2.2 years. There were 43 deaths. We calculated the following time domain measures of HRV from 24 hour Holters: SDNN (SD of normal RR intervals); ASDNN5 (mean of SD of normal RR intervals in 5 minute segments); SDANN5 (SD of mean normal RR intervals in 5 minute segments).

Cox regression analysis revealed significant associations between HRV and survival with the following relative risks for 25th vs 75th percentiles – SDNN: 1.8; ASDNN5: 2.6 and SDANN5: 1.7. After adjusting for major demographic and prognostic factors, decreased measures of HRV predicted a 1.6